VERIFICATION OF A TRANSLATION

I, Bastiaan Wilhelmus Herman Langenhuijsen, European patent attorney, hereby declare that:

I am knowledgeable in the Dutch and English languages, and I certify that the attached English translation of Dutch priority application Serial No. 1025308 filed on January 23th 2004, is a true and complete translation of said application to the best of my knowledge and belief.

By : .....

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Apparatus, vehicle and method for cleaning surfaces

The invention relates to an apparatus for cleaning surfaces. The invention also relates to a vehicle for cleaning surfaces. The invention further relates to a method for cleaning surfaces.

Diverse apparatus are known in the prior art which are adapted to clean surfaces. Particularly when the surface is contaminated seriously and/or for a long period, it is generally difficult to remove the fouling from the surface and thus actually clean the surface. Considerable fouling of floor surfaces occurs particularly in public traffic and pedestrian areas. For instance public highways, squares and pavements are thus frequently exposed to deposition (and growth) of all types of fouling, such as for instance chewing gum residues, oil, soot, algae, mosses and so on. Cleaning vehicles are therefore deployed regularly by diverse public agencies to remove the fouling deposited in public traffic and pedestrian areas. During displacement of the vehicle the relevant surface is swept, and optionally sprayed with a liquid, whereby generally a substantial part of the surface is cleaned. The cleaning vehicles are however not generally able to brush loose and/or release by softening all types of persistent adhered dirt, such as determined chewing gum residues and paint residues, in relatively rapid and effective manner so that this dirt can then be removed.

The invention has for its object to provide an improved apparatus for cleaning surfaces, with which persistent fouling residues can also be removed in a relatively short time from a surface for cleaning.

The invention provides for this purpose an apparatus of the type stated in the preamble, comprising a mobile support structure for: at least one supply container for cleaning agent, a plurality of spray units coupled to the supply container for spraying a surface for cleaning with cleaning agent, wherein each spray unit is adapted to spray the same part-surface a number of times during displacement of the support structure, and at least one pump for feeding cleaning agent under pressure to at least one spray unit, wherein at least a front spray unit, as seen in the direction of displacement of the support structure, lies at least substantially in front of another, rear spray unit. By applying a plurality of spray units positioned one behind the other, a surface for cleaning is first

cleaned a first time by the front spray unit, wherein the fouling is at least partially released by softening, and is subsequently cleaned for a second time by the rear spray unit in order to completely spray off the dirt released (to some extent) by softening, from the surface for cleaning. Owing to this dual, successive cleaning, a relatively effective and complete cleaning of surfaces can be achieved in a relatively short time. Each spray unit herein sprays the same part-surface at least twice in order to maximize the total cleaning of the surface. The pressure, temperature and quantity of cleaning agent sprayed onto the surface via the spray units can - depending on the nature and amount of fouling to be removed - vary per spray unit. The cleaning agent will generally be formed by a liquid, in particular water. (Environmentally-friendly) additives can optionally be added to the liquid to improve the surface cleaning. Each spray unit is preferably provided with one or more nozzles which can be of very diverse nature and design. The front spray unit and the rear spray unit will usually lie substantially in line with each other and, as assembly, also lie in line with the direction of displacement of the support structure, so as to enable maximizing of the part-surface cleaned by the two spray units. It is noted that in determined conditions it is also possible to envisage positioning more than two spray units (for instance three) successively as seen in the direction of transport of the support structure.

In a preferred embodiment, at least some of the number of spray units are adapted to spray the surface for cleaning in a substantially circular spray pattern. A circular spray pattern displacing during transport of the support structure is particularly effective in spraying a relatively large surface area a number of times with a single spray unit. The substantially circular spray pattern can be created in diverse ways by the spray unit. The spray unit can thus be provided with a spray aperture which extends all-around. The substantially circular spray pattern will generally be formed by one or more rotatable nozzles of the spray unit. For this purpose the spray units are preferably connected rotatably to the support structure. The substantially circular spray pattern can thus also be generated by embodying the spray unit as rotor on which one or more spray nozzles are arranged. The rotation speed of each rotor can preferably be regulated individually here.

In another preferred embodiment, the apparatus is provided with at least two spray sets, each provided with at least two spray units, wherein the spray sets, as seen in the

direction of displacement of the support structure, are positioned one behind the other. Diverse configurations of spray units can thus be applied, wherein other spray units are located adjacently of as well as behind or in front of each spray unit. A 2x2, 3x2, or 4x2 configuration of spray units will generally be most applied, wherein each spray set is thus provided with two, three or four spray units in mutually adjacent orientation. The spray units of a spray set need not necessarily lie in line, but can optionally have a staggered orientation.

The apparatus is preferably provided with suction means connected to the support structure for suctioning up cleaning agent applied to the surface. The sprayed cleaning agent and the fouling dispersed therein will thus be removed relatively rapidly and effectively from the surface, whereby no fouling residues, or hardly any, remain behind on the surface. The suction means preferably extend at least as far as the width of the surface sprayed by the spray units. The suction means are generally provided here with a suction nozzle. The suctioned-up, contaminated cleaning agent is generally guided via the suction nozzle to a separate waste container for temporary storage of the used, contaminated cleaning agent. In order to generate the suction action of the suction means, these latter are generally provided with a (vacuum) pump, the suction capacity of which can preferably be regulated.

The two-step cleaning of the surface for cleaning will generally be sufficient to clean the surface adequately. However, for cleaning of seriously contaminated surfaces, the apparatus is preferably provided with brushing means connected to the support structure for mechanically brushing the surface for cleaning. The brushing means can be of very diverse nature and design. Optionally rotatable annular brushes can for instance thus be applied. Preferably however, the brushing means are at least partially formed by one or more rotatable brush rollers. The brush roller is here preferably axially rotatable about a substantially horizontal axis. The brush roller can herein rotate, as seen in the transport direction of the support structure, in a forward direction and in a rearward direction. The rotation speed and the load exerted by the brush roller on the surface for cleaning can preferably be regulated per brush roller. At least one brush roller is preferably positioned between the front spray unit and the rear spray unit in order to further brush loose the dirt released to some extent by softening by the front spray unit before this dirt is once again sprayed intensively by the rear spray unit. In order to prevent, or at least

counter, released and/or brushed-loose dirt being flung about, the spray units and the brushing means are at least partly shielded by a shielding element. The shielding element will generally be formed by a hood substantially enclosing the spray units and the brushing means on the top side.

The apparatus is preferably provided with heating means connected to the support structure for heating cleaning agent to be applied to the surface for cleaning. The cleaning effect of the apparatus according to the invention can be considerably enhanced by spraying heated cleaning agent as hot liquid or even as steam onto the contaminated surface. Test results have shown that cleaning agent must have a temperature of at least 120, and preferably 150 degrees Celsius in order to enable a significantly improved cleaning capacity of the apparatus to be realized. The relatively hot cleaning agent will preferably be sprayed at an increased pressure of preferably at least 310, and more preferably at least 500 bar against the surface for cleaning. Such a pressure may however be too high for determined surfaces, such as older paved roads. For such structurally relatively weak roads a modified pressure of between 0 and 100 bar can be applied to spray the cleaning agent against the surface. In a particular preferred embodiment, the apparatus is provided with regulating means for regulating the temperature, pressure and/or the quantity of cleaning agent to be applied to the surface for cleaning. It is possible to opt for separate regulation of such parameters per spray unit in order to optimize the cleaning effect of the apparatus according to the invention.

In another preferred embodiment, the relative orientation of the spray units and the support structure can be changed. It is thus possible to displace the spray units to a position at a distance from the (underlying) surface and a position suitable for maintenance, transport or storage. The spray units are thus preferably displaceable between an active position of use, in which the spray units are adapted for spraying a surface for cleaning, and a non-active maintenance position, in which the spray units can for instance be disassembled from the support structure and then undergo maintenance operations.

The support structure can be embodied so as to be given for instance a handheld form and be operated to thus clean floors and/or walls. However, for cleaning of relatively

large public traffic and pedestrian areas, such as roads, pavements and so on, the support structure is preferably formed by a motorized vehicle. The spray units and optional brushing means are herein preferably positioned in front of the vehicle, wherein the supply container for the cleaning agent is preferably stationed at the rear of the vehicle.

In another preferred embodiment, the apparatus is provided with guide means for guiding the support structure along a predefined path. The support structure optionally provided with support wheels can thus be displaced along a rail for cleaning treatment of a predefined track.

The invention also relates to a vehicle of the type stated in the preamble, wherein the vehicle is provided with at least one supply container for cleaning agent, a plurality of spray units for spraying a surface for cleaning with the cleaning agent, wherein each spray unit is adapted to spray the same part-surface a number of times during displacement of the support structure, and at least one pump for feeding cleaning agent taken up from the supply container under pressure to at least one spray unit, wherein at least a front spray unit, as seen in the direction of displacement of the support structure, lies at least substantially in front of another, rear spray unit. Advantages of the vehicle according to the invention have already been described at length in the foregoing.

The invention further relates to a method for cleaning surfaces using such an apparatus, comprising the steps of: a) causing displacement of the support structure, b) spraying a part-surface a number of times with cleaning agent with at least one front spray unit, and, c) spraying the same part-surface a number of times with cleaning agent with at least one rear spray unit. The cleaning agent is preferably sprayed by the front spray unit and/or the rear spray unit onto the part-surface at a pressure of at least 310 bar. The cleaning agent sprayed by the front spray unit and/or the rear spray unit in the direction of the surface for cleaning preferably also has a temperature of at least 120 degrees, and more preferably at least 150 degrees Celsius.

The invention will be elucidated on the basis of non-limitative exemplary embodiments shown in the following figures, in which:

figure 1a shows a side view of a cleaning vehicle according to the invention in a non-active situation,

figure 1b shows a side view of the cleaning vehicle of figure 1a in an active situation,

figure 2 shows a detailed top view of a cleaning head of the cleaning vehicle of figures 1a and 1b,

figure 3 shows a detailed top view of another cleaning head for use in an apparatus according to the invention, and

figure 4 shows a cross-section of a handheld apparatus for cleaning surfaces according to the invention.

Figure 1a shows a side view of a cleaning vehicle 1 according to the invention in a non-active situation. Vehicle 1 comprises a water tank 2 filled with **clean** water and a gas boiler 3 coupled to water tank 2 for heating water from water tank 2. Vehicle 1 is provided with a gas bottle supply 4 with which the water can generally be heated continuously for a full working day. Vehicle 1 also comprises a pump 5 for pumping heated **clean** water under pressure to a cleaning head 6 connected to vehicle 1. Via cleaning head 6 the heated water can be sprayed against a surface for cleaning. The pump pressure can herein be varied, although a pressure of above 310 bar, such as for instance 350, 400 or 500 bar is preferably applied to spray the heated water against the surface. The temperature of the water leaving cleaning head 6 will generally be above 120, and preferably above 150 degrees Celsius. A substantial part of the water will therefore be sprayed out of cleaning head 6 as steam. It is noted that a detailed view of cleaning head 6 is shown in figure 2. Cleaning head 6 is shown in the shown exemplary embodiment in a retracted, non-active position. In this position it will generally not be possible to utilize the cleaning head 6 for cleaning surfaces, but maintenance to cleaning head 6 can for instance be carried out, or it is made possible to displace the vehicle over a relatively long distance at a relatively high speed. Figure 1b shows that cleaning head 6 is displaced downward to an active position in which cleaning head 6 can be utilized for cleaning an underlying surface. Heated water is sprayed in particular manner via pump 5 against the surface, whereafter possible fouling residues can be released from the surface. The mixture of water and fouling residues left behind can further be suctioned up via a suction conduit 7 in the direction of a dirt filter 8, whereafter the filtered water can be fed back to water tank 2. The water can thus be recycled continuously, whereby the efficiency of the system is further increased and the

environmental impact minimized. Cleaning head 6 is provided with a plurality of spray units (see figure 2) and a distribution element 9 for distributing the water flow as desired over the spray units. Distribution element 9 is herein coupled to a control unit 10 to enable regulation of the pressure and water flow rate per spray unit.

Figure 2 shows a detailed top view of cleaning head 6 of cleaning vehicle 1 as according to figures 1a and 1b. Cleaning head 6 comprises two spray sets 7 of three spray units 8 which are placed one behind the other and which are connected rotatably to vehicle 1. Each spray unit 8 is in fact formed here by a rotor 9 which is provided on opposite sides with two spray nozzles 10 extending in opposite directions. Rotors 9 can be driven electromechanically, although it is also possible to envisage causing the rotors 9 to rotate as a result of a water power generated during spraying. Broken lines 11 indicate that each spray unit 8 can generate a circular spray pattern to enable maximizing of the surface area for cleaning. The usual direction of displacement of vehicle 1, and therefore of cleaning head 6, is indicated by means of arrow A. Cleaning head 6 is also provided with two axially rotatable brush rollers 12, of which a front brush roller 12 is positioned between the two spray sets 7 and the rear brush roller 11 is positioned behind the two spray sets 7. Each brush roller 12 is herein constructed from a cylinder 13 around which a helical brush layer 14 is arranged, only part of which is shown here. A suction mouth 15 is positioned behind the final brush roller 12 in order to enable water sprayed by spray units 8 and the released fouling residues to be suctioned up and thus leave the surface uniformly cleaned. During displacement of cleaning head 6 in the direction A the front spray set 7 will first at least partially release dirt adhered to the surface by softening. Since each spray unit 8 sprays water on the surface in a circular spray pattern, each part-surface of the surface for cleaning will twice be sprayed intensively by a single spray unit 8. The softened dirt will then be further brushed loose to some extent by the front brush roller 12. By intensively spraying the pre-cleaned surface once again via the rear spray set 7, the dirt situated on the surface will be released substantially completely. The cleaning will be further intensified and completed by the rear brush roller 11, whereafter the contaminated water is drawn up via suction mouth 15 and thus discharged. Cleaning head 6 is fully covered by a hood 16 to prevent, or at least counter, dirt being flung around.

Figure 3 shows a detailed top view of another cleaning head 17 for use in an apparatus according to the invention. Cleaning head 17 is in fact a simplified embodiment of the cleaning head 6 shown in figure 2. Two spray heads 19 are arranged under a hood 18, wherein each spray head 19 is adapted to generate a fan-shaped spray pattern (shown hatched) on two sides. By displacing cleaning head 17 in the direction of arrow B, each underlying surface will in fact be sprayed four times, twice by the front spray head 19 and twice by the rear spray head 19, whereby an effective and substantially complete cleaning of a contaminated surface can be effected. The quantity of water or other liquid sprayed via spray heads 19, as well as the pressure and temperature of this water, can preferably be regulated individually per spray head 19. The water sprayed on the surface can further be discharged via a suction mouth 20.

Figure 4 shows a cross-section of a handheld apparatus 21 for cleaning surfaces according to the invention. Apparatus 12 is provided with a support structure 22 provided with a handle 23, a cleaning assembly 24, and two supply containers 25, 26 connected to support structure 22. One supply container 25 is adapted here to hold unused, clean cleaning agent and the other supply container 26 is adapted to hold used, contaminated cleaning agent. Cleaning assembly 24 is provided with a front spray head 27 for cleaning agent, an annular rotatable brush 28 and a following rear spray head 29 for cleaning agent. A suction means 30 is placed behind the rear spray head 29 in order to enable suctioning of at least a substantial part of the sprayed cleaning agent after use. A battery 31 is arranged in handle 23 to enable supply of electric power for the purpose of enabling spraying via cleaning assembly 24 and subsequent suctioning of the cleaning agent. The actual operation takes place via a switch 32 arranged in handle 23. The shown handheld apparatus 21 is particularly suitable for use in cleaning relatively small surfaces, such as floor parts or wall parts.

It will be apparent that the invention is not limited to the exemplary embodiments shown and described here, but that within the scope of the appended claims numerous variants are possible which will be self-evident to the skilled person in this field.

Claims

1. Apparatus for cleaning surfaces, comprising a mobile support structure for:
   - at least one supply container for cleaning agent,
   - a plurality of spray units coupled to the supply container for spraying with the cleaning agent a surface for cleaning, wherein each spray unit is adapted to spray the same part-surface a number of times during displacement of the support structure, and
   - at least one pump for feeding cleaning agent under pressure to at least one spray unit,

   wherein at least a front spray unit, as seen in the direction of displacement of the support structure, lies at least substantially in front of another, rear spray unit.

2. Apparatus as claimed in claim 1, characterized in that at least some of the number of spray units are adapted to spray the surface for cleaning in a substantially circular spray pattern.

3. Apparatus as claimed in claim 1 or 2, characterized in that the spray units are connected rotatably to the support structure.

4. Apparatus as claimed in any of the foregoing claims, characterized in that the apparatus is provided with at least two spray sets, each provided with at least two spray units, wherein the spray sets, as seen in the direction of displacement of the support structure, are positioned one behind the other.

5. Apparatus as claimed in any of the foregoing claims, characterized in that the apparatus is provided with suction means connected to the support structure for suctioning up cleaning agent applied to the surface.

6. Apparatus as claimed in any of the foregoing claims, characterized in that the apparatus is provided with brushing means connected to the support structure for brushing the surface for cleaning.

7. Apparatus as claimed in claim 6, characterized in that the brushing means are at least partially formed by at least one brush roller.

8. Apparatus as claimed in claim 7, characterized in that at least one brush roller is positioned between the front spray unit and the rear spray unit.

9. Apparatus as claimed in any of the claims 6-8, characterized in that the spray units and the brush means are at least partially shielded by a shielding element.

10. Apparatus as claimed in any of the foregoing claims, characterized in that the apparatus is provided with heating means connected to the support structure for heating cleaning agent to be applied to the surface for cleaning.

11. Apparatus as claimed in any of the foregoing claims, characterized in that the apparatus is provided with regulating means for regulating the temperature, pressure and/or the quantity of cleaning agent to be applied to the surface for cleaning.

12. Apparatus as claimed in any of the foregoing claims, characterized in that the relative orientation of the spray units and the support structure can be changed.

13. Apparatus as claimed in any of the foregoing claims, characterized in that the support structure is formed by a vehicle.

14. Apparatus as claimed in any of the foregoing claims, characterized in that the apparatus is provided with guide means for guiding the support structure in a predefined path.

15. Vehicle for cleaning surfaces, wherein the vehicle is provided with at least one supply container for cleaning agent, a plurality of spray units for spraying a surface for cleaning, with the cleaning agent, wherein each spray unit is adapted to spray the same part-surface a number of times during displacement of the support structure, and at least one pump for feeding cleaning agent taken up from the supply container under pressure to at least one spray unit, wherein at least a front spray unit, as seen in the direction of

displacement of the support structure, lies at least substantially in front of another, rear spray unit.

16. Method for cleaning surfaces using an apparatus as claimed in any of the claims 1-15, comprising the steps of:

a) causing displacement of the support structure,

b) spraying a part-surface a number of times with cleaning agent with at least one front spray unit, and

c) spraying the same part-surface a number of times with cleaning agent with at least one rear spray unit.

17. Method as claimed in claim 16, characterized in that the cleaning agent is sprayed by the front spray unit and/or the rear spray unit onto the part-surface at a pressure of at least 310 bar.

18. Method as claimed in claim 16, characterized in that the cleaning agent sprayed by the front spray unit and/or the rear spray unit in the direction of the surface for cleaning has a temperature of at least 120 degrees Celsius.

Abstract

The invention relates to an apparatus for cleaning diverse types of surface, such as public highways, pavements, squares and so on. The invention also relates to a vehicle for cleaning such surfaces. The invention further relates to a method for cleaning such surfaces.

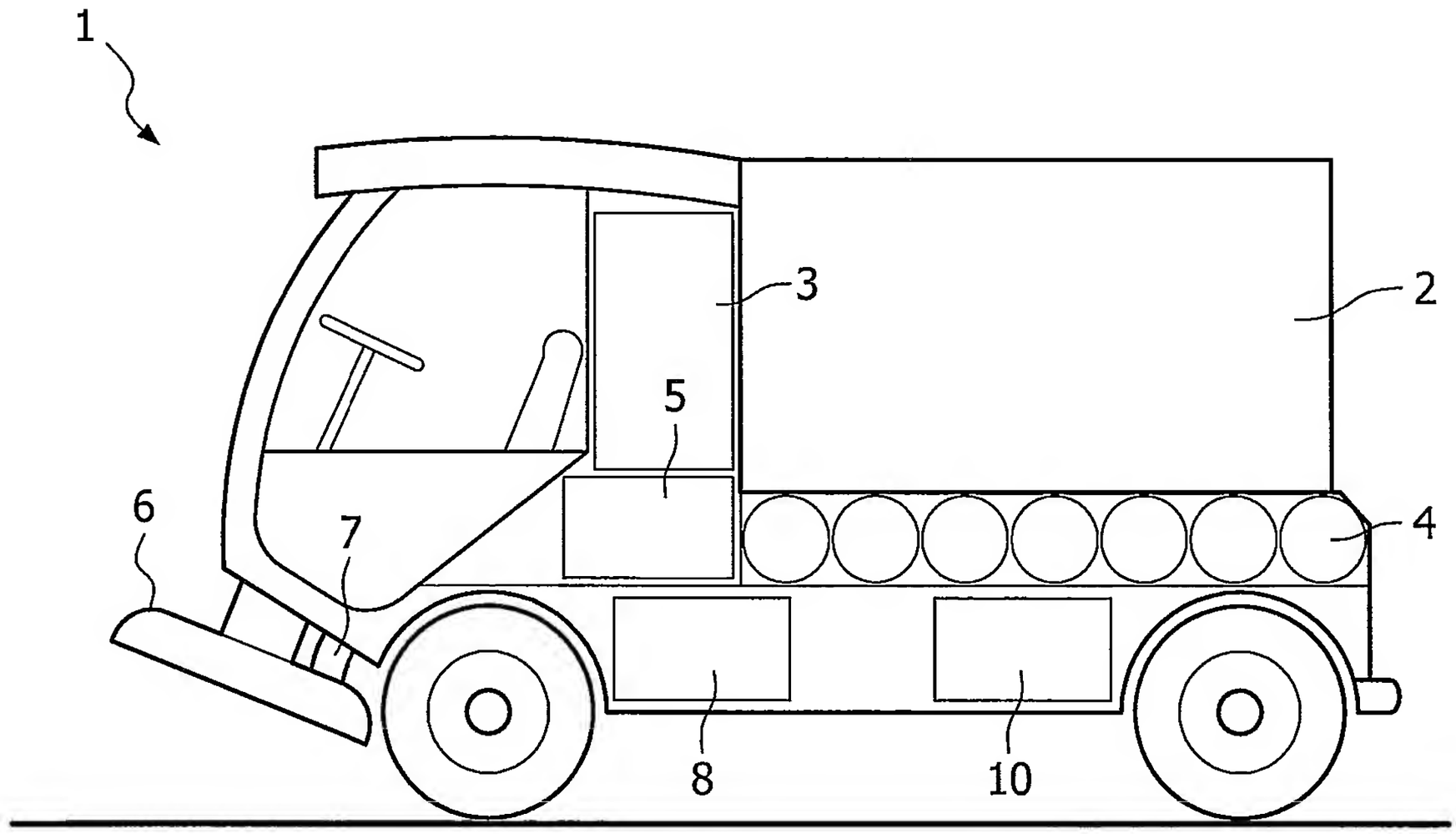

FIG. 1A

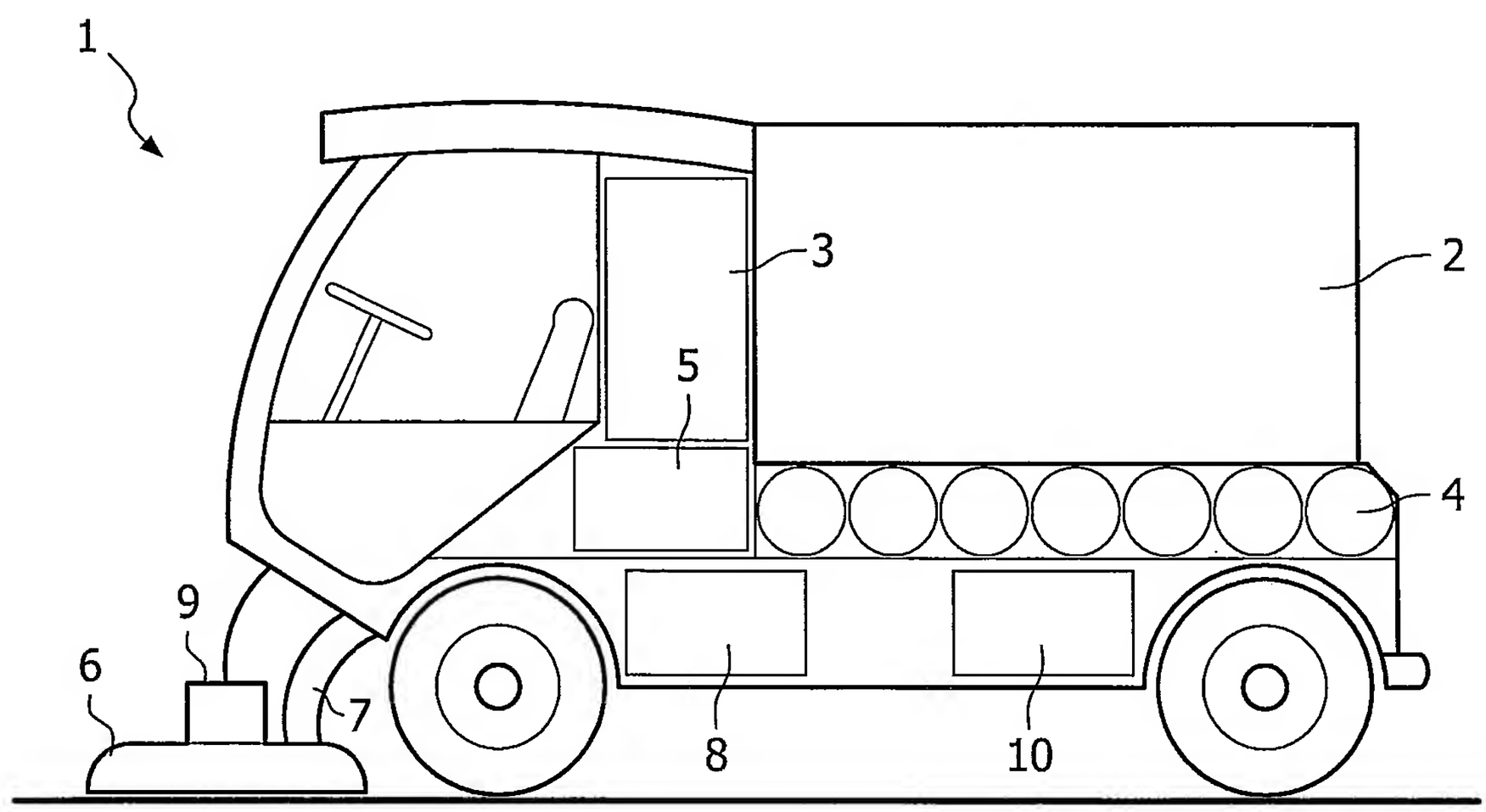

FIG. 1B

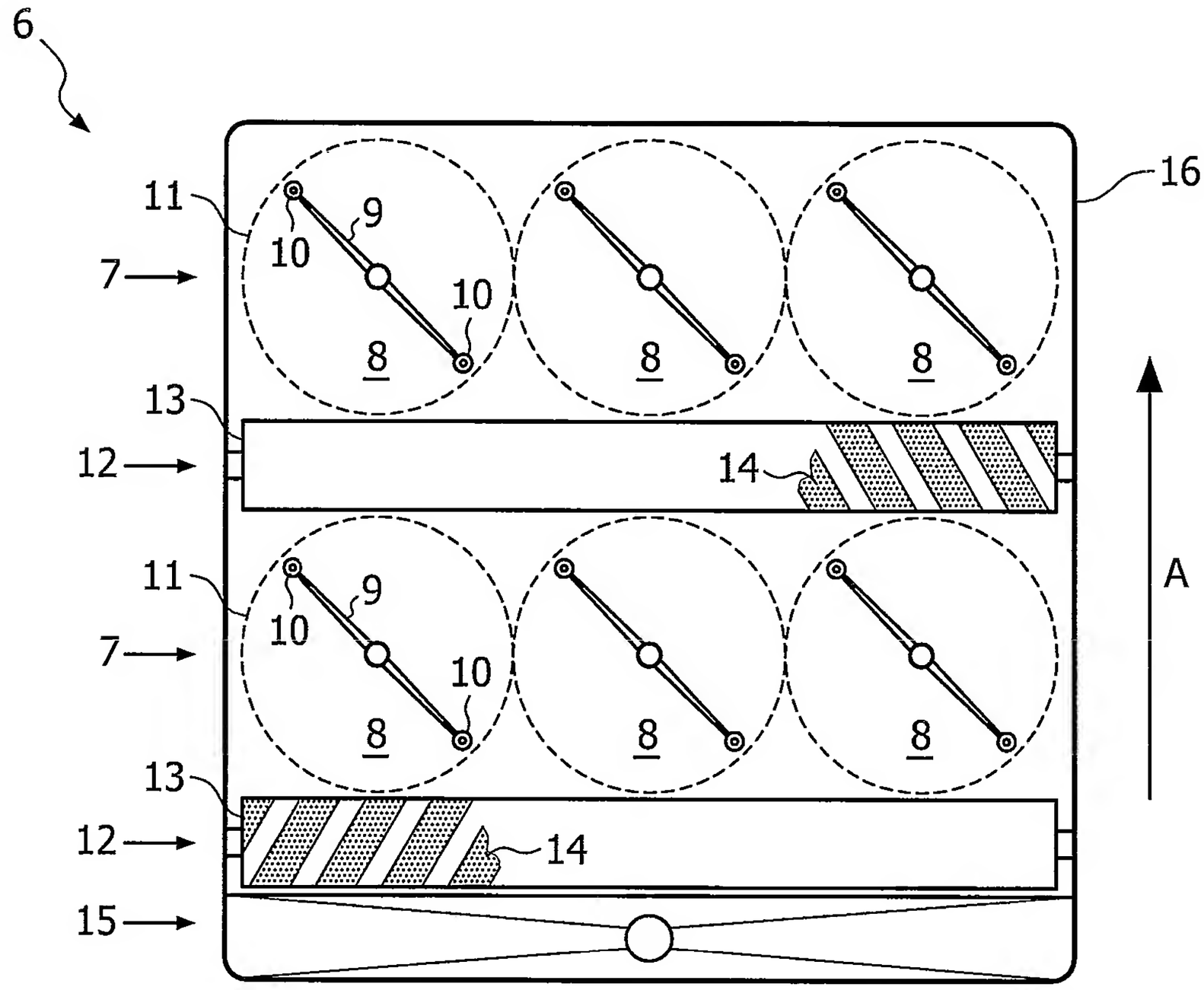

FIG. 2

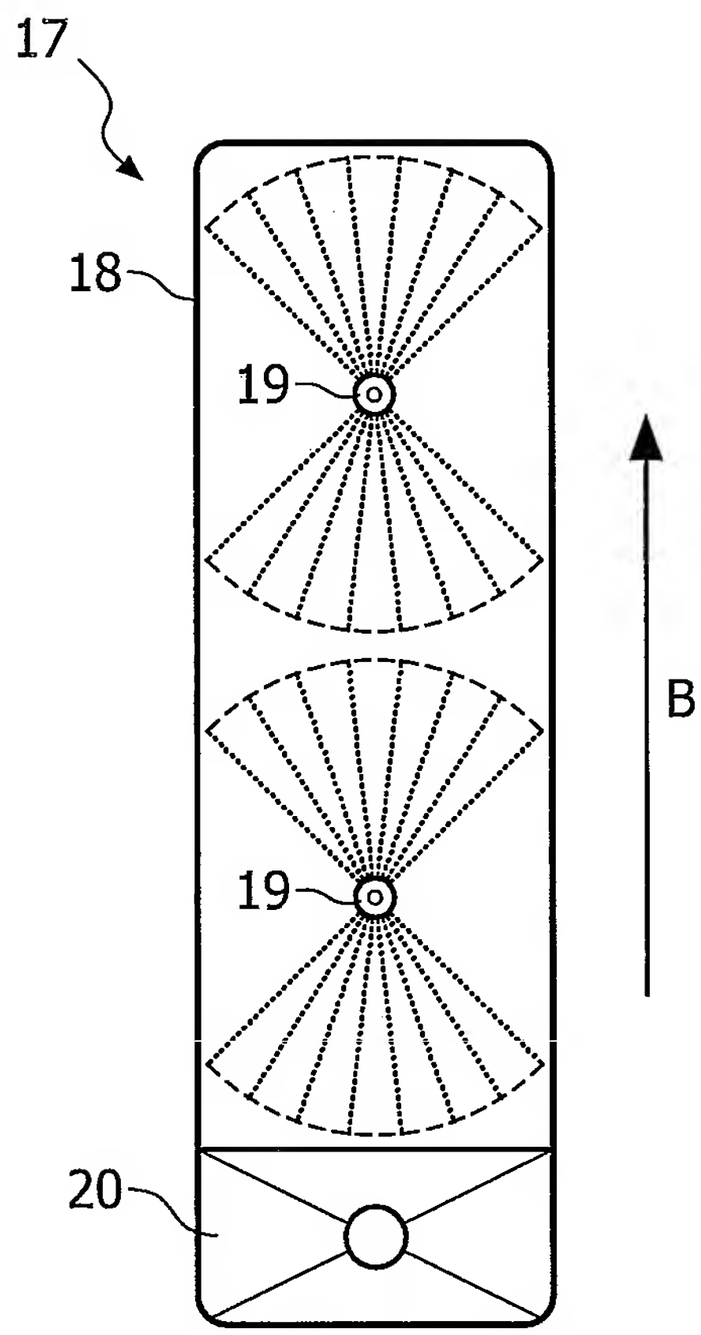

FIG. 3

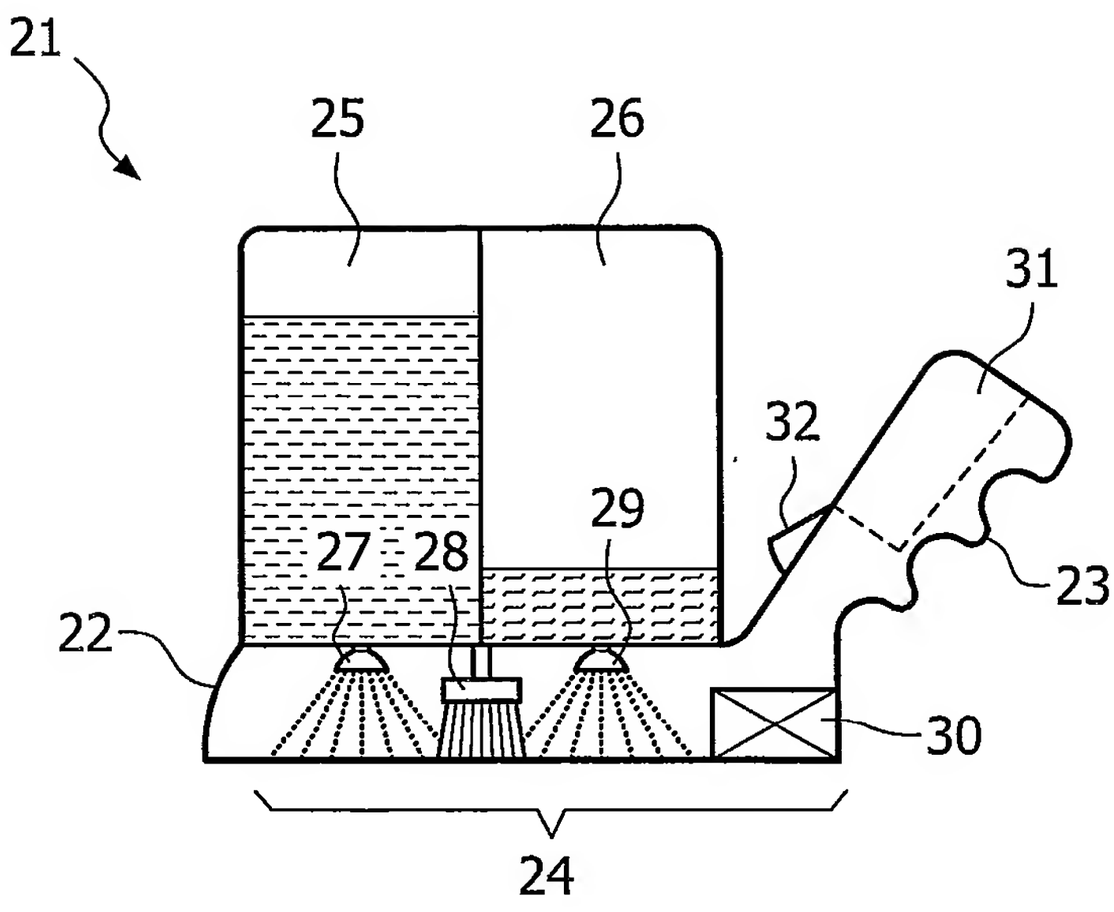

FIG. 4